

WHAT IS CLAIMED IS:

1 1. A method of increasing the efficiency of transformation of cycling cells,
2 comprising:

3 synchronizing cells at a first stage of the cell cycle by contacting said
4 cells with electromagnetic radiation, and

5 transforming said cells at a second stage of the cell cycle within about
6 one cell cycle of said first stage with a nucleic acid that encodes a desired gene product.

1 2. A method of claim 1 wherein said electromagnetic radiation synchronizes
2 cells at a stage of the cell cycle when the nuclear membrane is substantially degraded.

1 3. A method of claim 1 wherein said electromagnetic radiation synchronizes
2 cells at late S phase.

1 4. A method of claim 1 wherein said electromagnetic radiation synchronizes
2 cells at the G₂/M phase boundary.

1 5. A method of claim 1 wherein said electromagnetic radiation synchronizes
2 cells at a stage other than M phase, and the nucleic acid accumulates in cells that have cycled to
3 the G₂/M phase boundary.


1 6. A method of claim 1 wherein said first stage and said second stage are the
2 same.

1 7. A method of claim 1 wherein said therapeutic gene is foreign to said cells.

1 8. A method of claim 1 wherein said gene product of said therapeutic gene is
2 toxic to said cells.

1 9. A method of claim 8 wherein said gene product of the therapeutic gene
2 induces apoptosis.

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1  10. A method of claim 1 wherein said nucleic acid is part of a lipid-nucleic
2 acid particle.

1 11. The method of claim 1 wherein said electromagnetic radiation is a
2 member selected from the group consisting of Gamma rays, X-rays, ultraviolet rays, infrared
3 rays and microwaves.

1 12. The method of claim 11 wherein said electromagnetic radiation is X-
2 rays.

1 13. A method of inhibiting the growth of cancer cells, comprising:
2 exposing a cancer patient to an amount of electromagnetic radiation that
3 is effective to synchronize cancer cells of said patient at a first stage of the cell cycle; and
4 administering to said cancer patient a nucleic acid that transforms
5 cancer cells of said patient;
6 wherein the expression of said nucleic acid inhibits the growth of said
7 cancer cells.

1 14. The method of claim 13 wherein said cancer cells are synchronized at a
2 stage when the nuclear membrane is substantially degraded.

1 15. The method of claim 13 wherein said electromagnetic radiation
2 synchronizes the cell cycle at late S phase.

1 16. The method of claim 13 wherein said electromagnetic radiation
2 synchronizes the cell cycle at the G₂/M interphase.

1 17. The method of claim 13 wherein said electromagnetic radiation
2 synchronizes the cell cycle at a stage other than M phase, and the nucleic acid accumulates in
3 cells when a plurality of cells exposed to the agent have cycled to the G₂/M interphase.

1 18. A method of claim 13 wherein said first stage and said second stage are
2 the same stage of the cell cycle.

1 19. A method of claim 13 wherein said nucleic acid encodes a therapeutic
2 gene.

1 20. A method of claim 19 wherein said therapeutic gene is foreign to said
2 patient.

1 21. A method of claim 20 wherein said gene product of said therapeutic gene
2 is toxic to said cancer cells.

1 22. A method of claim 21 wherein said gene product of said therapeutic gene
2 induces apoptosis of said cancer cells.

1 23. A method of claim 13 wherein said nucleic acid is part of a lipid-nucleic
2 acid particle.

1 24. A method of claim 13 wherein said nucleic acid is administered
2 systemically.

1 25. A method of claim 13 wherein said therapeutic gene is expressed in said
2 cancer cells.

1 26. A method of claim 25 wherein said therapeutic gene is HSV-TK and
2 ganciclovir is also administered to said cancer patient

1 27. The method of claim 13 wherein said electromagnetic radiation is
2 selected from the group consisting of Gamma rays, X-rays, ultraviolet rays, infrared rays and
3 microwaves.

1 28. The method of claim 17 wherein said electromagnetic radiation is X-
2 rays.

1 29. The method of claim 13 wherein said patient is exposed to said
2 electromagnetic radiation prior to administering said nucleic acid.

1 30. The method of claim 29 wherein said patient is exposed to said
2 electromagnetic radiation at least 32 h prior to administering said nucleic acid.

1 31. The method of claim 29 wherein said patient is exposed to said
2 electromagnetic radiation at least 48 h prior to administering said nucleic acid.

1 32. The method of claim 13 wherein said nucleic acid is administered to said
2 patient prior to exposing said patient to said electromagnetic radiation.

1 33. The method of claim 32 wherein said nucleic acid is administered to said
2 patient at least 32 h prior to exposing said patient to said electromagnetic radiation.

1 34. The method of claim 32 wherein said nucleic acid is administered to said
2 patient at least 48 h prior to exposing said patient to said electromagnetic radiation.

1 35. A method of enhancing the therapeutic effect of a foreign therapeutic
2 gene administered to a patient, comprising the steps of
3 (a) exposing said patient to an amount of electromagnetic radiation that
4 is effective to synchronize the cells of said patient at a first stage of the cell cycle; and
5 (b) administering said foreign therapeutic gene to said patient within
6 seven days of step (a).

1 36. The method of claim 35 wherein step (b) is performed within 3 days of
2 step (a)

1 37. The method of claim 35 wherein step (b) is performed within 24 hours
2 of step (a).

1 38. The method of claim 35 wherein said foreign therapeutic gene is a
2 plasmid.

1 39. The method of claim 35 wherein said foreign therapeutic gene
2 comprises a gene selected from the group consisting of genes encoding a cytokine, apoptotic
3 protein, tumor suppressor, heat shock protein, immunogenic antigen, proteinase inhibitor,
4 anti-angiogenic protein, suicide gene for use in GDEPT, ribozyme, antisense nucleic acid,
5 viral protein and a toxin.

1 40. The method of claim 35 wherein said foreign therapeutic gene is
2 administered systemically.

1 41. The method of claim 35 wherein said foreign therapeutic gene is
2 administered locally or regionally.

1 42. The method of claim 35 wherein said foreign therapeutic gene is
2 administered locally or regionally.

1 43. The method of claim 35 wherein said foreign therapeutic gene is fully
2 encapsulated in a lipid formulation such that less than 5% of the gene is degraded after
3 exposure of the formulation to 1 U DNase I for 30 minutes in digestion buffer at 37°C.

1 44. The method of claim 35 wherein said electromagnetic radiation is
2 selected from the group consisting of Gamma rays, X-rays, ultraviolet rays, infrared rays and
3 microwaves.

1 45. The method of claim 38 wherein said electromagnetic radiation is X-
2 rays.

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